

Syllabus  
SM279  
Multivariable Calculus

1. Affine Geometry of  $\mathbb{R}^n$ 
  - a. Lines - Parametric
  - b. Planes - Parametric
  - c. Subspaces
    - Review
    - i. Linear Independence
    - ii. Spanning
    - iii. Bases
    - iv. Dimension
  - d. k-dimensional affine sets – parametric
  - e. Dot Product
  - f. Implicit form for Affine sets
    - i. Hyperplanes
    - ii. Review of Solutions of Equations
  - g. Convex Sets
  - h. Open Balls
  - i. Interior, Exterior and Boundary Points
  - j. Open and Closed Sets
2. Functions from  $\mathbb{R}^n$  to  $\mathbb{R}^m$ .
  - a. Curves in  $\mathbb{R}^n$ .
  - b. Surfaces in  $\mathbb{R}^n$
  - c. Linear Functions
    - i. Review of Matrix Operations
  - d.  $\mathbb{R}^n$  to  $\mathbb{R}^m$  functions
  - e. Partial Derivatives
  - f. Derivative Matrix
  - g. Directional Derivative

3. Chain Rule
  - a. Chain Rule Theorem
  - b. Inverse Function Theorem
  - c. Implicit Function Theorem
4. Generalized Inner Products
  - a. Change of Coordinates
    - i. Review Coordinates
  - b. Perpendicular Subspaces
    - i. Review Rank-Nullity Theorem
  - c. Positive Definiteness
    - i. Review Determinants
    - ii. Review Gram- Schmidt Process
5. Unconstrained Optimization
  - a. Second Derivative Test
6. Constrained Optimization
  - a. Second Derivative Test
7. Systems of Differential Equations
  - b. Review Eigenvalues/Eigenvectors